Philosophy vol 8

AN ESSAY TO SHEW THE CAUSE OF ELECTRICITY; AND Why Some Things are Non-Electricable.

In which is alſo Conſider'd

Its Influence in the *Blaſts* on Human Bodies, in the *Blights* on Trees, in the *Damps* in Mines; and as it may affect the *Senſitive Plant*, &c.

In a LETTER

To Mr. WILLIAM WATSON, *F.R.S.*

By JOHN FREKE, Surgeon to *St. Bartholomew's* Hoſpital, *London*, F. R. S.

Naturam expellas furcâ, tamen uſque recurret.

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BRITISH MUSEUM

TO

MARTIN FOLKES, Eſq;

PRESIDENT

OF THE

ROYAL SOCIETY.

SIR,

THOSE who have the Honour of your Acquaintance, and thence know your many excellent Qualifications, muſt applaud my Choice in dedicating this ſmall Piece to you; whoſe Name, if there be any Merit in the Performance, will, before any other, add a Luſtre to it. I am, with the higheſt Eſteem,

Your moſt Obliged,

Humble Servant,

JOHN FREKE.

The PREFACE.

WHEN I firſt enter'd on this Subject of Electricity, *I intended only to put ſome Thoughts in Writing concerning it, that I might the more eaſily convey them to the Underſtandings of ſuch as I hoped would be more likely than I ſhould be to go farther with it. And as nobody, either here or abroad, had publiſhed any thing touching the Cauſe from which it was produc'd, I choſe to ſhew the Beginning I had made to ſome Friends, whoſe Opinion concerning Natural Knowlege I had a great Reliance on. I told* *them, I thought my Difficulty would be to convey what I had to propound on this new Subject to them with the neceſſary Clearneſs, as my Intention was to obſerve the utmoſt Brevity in it.*

After I had read it to them, they aſſured me that what I had written was perfectly intelligible; and that it gave them many new Ideas reſpecting this Phænomenon; *and were very earneſt with me to print it, for the ſake of the Publick.*

I was not, however, inclined to comply with their Requeſts, till I had ſhewn it to a Perſon who is moſt juſtly diſtinguiſh'd for his great Candor, and ſuperlative Underſtanding in all Natural Knowlege; and he likewiſe having expreſs'd *expreſs'd his Wiſhes to ſee it in Print, I could not but look on his Deſire as a Command.*

If what I have here undertaken to ſhew ſhould enlighten the Minds of any of my Readers, or if it ſhould ſo far awaken the Attention of others, as to make them give better Reaſons for the Operation of this Power of Electricity than I have done, I ſhall not account the Time ill ſpent, which I have employ'd on this intereſting Subject: A Subject which can, with more Nobleneſs and Dignity employ the Mind of Man, than any I can think of relating to the ſublunary Part of this World. For by it you may be acquainted with the immediate Officer of God Almighty, *which he ſeems to ſend to all Things living.*

living. Nay, this Power, according to my Conception, ſeems to be the Cauſe, under HIM, *both of Life and Death. And when it may be more fully underſtood, it may afford us Means whereby we may be better enabled to reaſon more intelligibly than now we can, concerning various Operations in Nature.*

I am very ſenſible what Tribute a new Author is liable to pay to Criticks: I know it is too common to find much too large a Part of them inclin'd to look into a Book for its Faults, rather than for its Uſe; and are more ready to pull down, than they have Abilities to put any thing in its Place. But as I am not writing this for any Gain to myſelf, but the Pleaſure of informing, if I can, the Minds of ſuch as may be *be informed by it, I chuſe rather to ſtand their Cenſure, than deny the Publick what may poſſibly be the Beginning of much Good.*

It is very probable, that thoſe who pretend to know every thing, will be ſo good as to ſay, if they like what I have advanc'd, that it ſquares exactly with what they thought before concerning it: And thoſe who ſet up for Criticks will try their Hands at this Performance, and, if they can, will condemn it.

It would be a great Wonder, indeed, if this ſhould eſcape the Cenſure of ſome, when the great Dr. Harvey *had his implacable Adverſaries to his Account of the Circulation of the Blood; and even Sir* Iſaac Newton *met with Opponents* *to ſeveral of his Theorys. What I have ſaid oppoſes no one's Scheme, that I know of; it offers no Sentiments which can hurt any Man.*

I have advanc'd only Conjectures for the clearing thoſe Truths I would eſtabliſh; and if, after all, what appears reaſonable to me ſhould not appear ſo to others, I cannot help it: For it is impoſſible for all Men to ſee the ſame Thing in one and the ſame Light, even though they were Men of the beſt Erudition. I would hope, that what I have undertaken to ſhew, is what all ſenſible Men would be glad to have ſhewn.

AN

ESSAY

To Shew

From what CAUSES Electricity is Produced, &c.

Kind Sir,

WHEN I reflect on the great Ingenuity you have ſhewn, in your *Apparatus* for the Improvement of the Knowlege of Electricity, and how induſtrious and kind you have been in communicating the many Experiments you have made to your Friends and Acquaintance relating thereto, I was in hopes, from you or ſome of them, an Eſſay would be made ere this, not only to go farther with theſe Experiments, but to give ſome tolerable Conjecture from whence this Fire, and aſtoniſhing Effect, is produced.

I was going to give you my Thoughts concerning it, when I laſt ſaw you at *Child*'s Coffee-houſe; but, on Reflection, I choſe rather to do it in Writing: For, in all Novelty, till the Relater is quite underſtood, Words are forgotten eaſily; but Things of this ſort in Writing may again and again be conſider'd.

To begin then: In order to ſhew whence this electrical Fire and Force is produc'd, I will firſt endeavour to prove, that it ariſes not from any of the *Apparatus* itſelf; not either from the glaſs Ball, nor the Leather, nor from the Tube, or Hand that rubs it;

Becauſe nothing we know of can ſend out of it a Quantity of Matter, but there muſt be leſs of that Matter remaining, after it has been ſo diſcharged; whereas it cannot be ſhewn, but that the Ball of Glaſs, after ever ſo many Times uſing, remains as fit for the ſame Uſe as at firſt.

Having, from Probability, I think, ſhewn, that the Fire and Force, here treated of, come not from the *Apparatus*, it is natural for me to ſuppoſe they are produced from the Air they are mov'd in. And I believe this Notion will not appear trifling, when we conſider, that the moſt ancient and ableſt Philoſophers have look'd upon the Animal and Vegetable World as actuated by Fire; and that they are nouriſh'd by Water, and what it contains. If this be allow'd, then the

Air, which is eſteem'd the *Pabulum Vitæ*, from its rubefying the Blood of all Animals in Reſpiration, ſeems to be univerſally impregnated with this Fire. And tho' there is not enough of it ſo diſperſed as to hurt the Animals in Reſpiration, yet I can ſuppoſe it as univerſally diſperſed, as I can a ſmall Quantity of any Liquor dropp'd in Water, which, when ſo diſperſed, is of no Harm to a Patient, though a few Drops of it by themſelves would have been certain Death. And yet, if you farther conſider it ſo diſperſed, you cannot conſider one Particle of the Water without a Particle of the Medicine: Juſt ſo it may be with the Fire of this lower Region, or, what I chuſe rather to call it, this *Flamma Vitalis*.

I proceed now to conſider, how this Fire, ſo diſperſed, may be collected; and have given to it, in electrical Experiments, a Force equal to, and of the ſame Nature with, Lightning.

To make this Conjecture the more eaſily apprehended, I will ſuppoſe, that the Nature of Fire is as ſimilar to its Parts, and they have as great a Propenſity to adhere to one another, as we find the different Arrangements in all natural Bodies have; as may be ſeen in Gems, in Water, and in the various *Strata* of the Earth, and the like. Do but force or invite theſe fiery Particles to a cloſer Contact than they have been ſuppoſed to be in, when uniformly diſperſed through all Nature, and they are Lightning, or a

Fire of leſs Force, as more or leſs Parts of that Fire are got together.

To illuſtrate this, wax a ſmall Thread, or ſlide a Rope ſwiftly thro' your Fingers, and you are liable to burn them: Which probably ariſes from their grinding in, betwixt your Fingers and the Rope, ſo many more Particles of Fire than naturally come together when left to float in the Air.

If this Reaſoning be allow'd to be juſt (which it muſt be, till it is overturn'd by ſtronger Reaſoning), then it follows, that the Air, which is violently ground or rubb'd betwixt your Hand and a glaſs Tube, or betwixt a glaſs Ball whirl'd briskly, and rubb'd with a Piece of Leather, as they are uſed in electrical Experiments,

ments, I ſay, the Air, ſo rubb'd, may leave behind it that Quantity of agitated Fire which cauſes Electricity.

For, ſuppoſe the Ball or Tube inveloped with a Quantity of this Fire moving ſpirally round them, with the utmoſt Velocity; and it can no more depart from its Company than you find Sparks of Fire which fly from Steel on a Knife-grinder's Wheel are liable to do. Every body almoſt can remember to have ſeen them adhere to the Wheel, and frequently purſue each other quite round it.

Thoſe who try theſe Experiments, find, that in moiſt Weather this Power is leſs attainable than in a more clear Day; and therefore ſome may be liable to attribute that to the *Apparatus*, which may be better accounted for by the watry Particles in the Air;

which may be liable to hinder the lambent Flame, by me ſuppoſed to be univerſally ſcatter'd, from uniting, by the Friction before-mention'd.

As I have mention'd Friction, I cannot help obſerving how unphilophical and unmeaning it is, for any one to advance, that Fire is cauſed by Friction; when I think he may as well ſay, that Water is cauſed by Pumping.

We know, that a Cart or Coach-Wheel, for Want of Greaſe, by Friction will be ſet on Fire; and Fire-Canes, rubbed together ſmartly, will take Fire; but neither of theſe, I believe, nor any thing elſe, will beget or generate the Element of Fire. They muſt either collect it out of the Air, or elſe it muſt be lodged within them, as we find it to be in Steel in an eminent Degree: For, if you drop the Filings of Steel through the Flame of a Candle, it ſends out the moſt fierce Fire of any thing in Nature.

The Reaſon to be given why a greater Quantity of Fire is produced from Steel-Filings, than from any other Thing, I take to be owing to a larger Share of that Element which is impacted in it from its being made out of Iron long impregnated with Fire.

Many other Bodies have actual Fire impacted in them, as Flints, and many other hard Stones and Metals; but whenever you produce Fire from Steel-Filings, you find that Steel melted: So when Fire is produced from Stones, and the like, each Spark is Part of that Stone burnt to a *Calx*.

Now, as I am endeavouring to ſhew to you the natural Coheſion of Fire, and the Propenſity there is in it to extend itſelf, I ſhall offer to your Conſideration a very familiar Inſtance to prove it; which is that of the Snuff of a Candle juſt blown out. You cannot but have obſerv'd at how great a Diſtance from the Snuff the Flame will deſcend down the Smoke, and light it.

I ſhall further take the Liberty to obſerve to you another Proof of this; which, I think, will not only ſhew a Propenſity in Fire to cohere, but will greatly ſtrengthen my Conjecture, that this Fire, produced in Electricity, is extracted from that I have ſuppoſed to be univerſally diſperſed.

A Perſon, who liv'd in the Town of *Warham* in *Dorſetſhire*, in the

Year 1703, informed me, that in the Night of the great Hurricane and high Wind, in the ſtrongeſt Part of the Tempeſt, he ſaw from his Window, on the neighbouring Hills, great Bodies of Fire, ſwiftly paſſing over them on the Ground.— Now whence aroſe that Fire, if it came not from the Air impelling it into thoſe Flakes? And its ſubſiſting together in that Hurricane ſhews, I think, very plainly, that if its Coheſion had not been natural, the Wind would then have ſcatter'd it.

Though I apprehend that the Four Elements of Fire, Water, Earth, and Air, may never have been increaſed or diminiſhed, ſince the Great GOD of Order created them, yet I can alſo apprehend each of them unequally diſpers'd in the Univerſe by various Cauſes and Events: And when this happens, thoſe which were intended, when in their due Order, to make every thing happy and eaſy, in their diſordered State will create nothing but Confuſion.

For Inſtance, the chief Uſe of Water ſeems intended, when deſcending in warm and gentle Showers, or flowing in kind and eaſy Streams, to chear and nouriſh all Kinds of Vegetation, as well in Trees and Plants, as in Herbs and Flowers: But ſuppoſe, by the Contrivance of Man, or by the Accidents of Nature, a large Quantity of it lodged on the Tops of high Hills, if it breaks its Bank, it will never ſtop, till it finds a natural reſting Place; and in its Torrent it will overwhelm and deſtroy thoſe Trees and

Plants, with the Herbs and Flowers, it was intended to nouriſh.

The like may be ſaid of the Fire, which I have been ſuppoſing uniformly diſperſed over the Creation; which, if its Properties are to invigorate all Nature, you muſt of courſe ſuppoſe its Power not to be controul'd; but that it paſſes through all the Animal, Mineral, and Vegetable Creation, whilſt they ſtand in need of Life, or any Increaſe.

But as I have been conjecturing what different Purpoſes Water in its diſorder'd State may produce, ſo the ſame Conſideration may be had concerning Fire in its diſorder'd State: When too much of it is brought together, either by the Contrivance of Man, or by the Diſorders in the other

Elements; is it not reaſonable to ſuppoſe, that it will, according to its natural Appointment, get about its Buſineſs, and break as ſoon as it can from its Confinement?

A very learned and eminent Author, who is now living, ſays, "That "all Life, whether it be vegetable, ſen"ſitive, or animal, is only a kindled "Fire of Life in ſuch a Variety of "States: And every dead inſenſitive "Thing is only ſo becauſe its Fire is "quenched."

It had been impoſſible that this wonderful *Phænomenon* of Electricity ſhould ever have been diſcover'd, if there had not been ſuch Things as are non-electricable. For, as faſt as this Fire had been driven on any thing, its next Neighbour would have carried it further:

ther: But, when it was moſt wonderfully found out, that any thing which was ſuſpended in a ſilk Cord (that being a Non-electricable) was obliged to retain the Fire, which by electrical Force was driven on it; and when, moreover, it appeared, that any Perſon or Thing being placed on a Cake of Bees-wax (which alſo is a Non-electricable), it could no more part with its Fire, than when ſuſpended in a ſilk Cord, I think it will become worth Inquiry, why they are not electricable.

To prove this, I would reflect upon the Paſſage before-quoted: For from thence I think it muſt follow, that if Fire be the Cauſe of the Life and Increaſe in any thing, then, whatever ceaſes to be in a State of Life or Increaſe, can no longer be ſuppoſed to be capable of them; and therefore muſt be conſider'd as a *Caput mortuum.* Of this ſort are Bees-wax and Silk, both being non-electricable.

To purſue this kind of Reaſoning concerning them: They are, in truth, the Excrements only from thoſe Beings which once had Life in them; the Wax being the excrementitious Matter from Bees, which, when made, was to be capable of no further Increaſe or Addition to its Nature: For, as its primitive Uſe was only intended to make Combs or Cells to preſerve the Honey through the different Changes of the Seaſon, ſo if this Wax had been liable to Alterations from this Fire (as all Things which are endued with it are) then the Cells would not have remained ſo intire as the wonderful Architects left them.

As concerning the Silk, I look on it as an excrementitious Matter alſo; deſigned by GOD Almighty (who makes nothing in vain) to become a *Capſula* or Coffin to preſerve the Inſect in it ſafely, for ſuch a Seaſon as was intended it ſhould remain there.

All reſinous Bodies are likewiſe non-electricable; which I think will tend rather to prove my Conjecture to be true than falſe: For, are there ſuch Things as Pitch or Reſin in *Nature*? Are they not made out of the Juice of Plants? Which Plants, whilſt they remained in the Life of Nature, had nothing but their unalter'd Juice in them. Pitch and Reſin became ſo by Art; and therefore no Time or Chance can give an Increaſe to their Quantity: From whence they may be ſuppoſed not to be in the Courſe of Nature.

I am aware what Objection this is liable to; for, though it muſt be acknowleg'd that theſe Things are non-electricable, it may be asked, If they are not the moſt inflammable Things that can be imagined, and, conſequently, ſuſceptible of Fire; becauſe Candles are made out of Wax, and Torches out of Pitch and Reſin? To which I anſwer, That here it may be neceſſary to inquire, what occaſions this Flame, which is produced either from the Candle or Torch? Can this Flame ſubſiſt one Moment, without the Paſſage of Air through it? I anſwer, No. Well then, as this

Treatiſe is not intended merely to ſtate Facts, but to account for the Nature of them, by the beſt Conjectures I can make, pray why does Air keep this Flame ſubſiſting? If you will ſuppoſe, with me, that the Cauſe of all Heat, and the Appearance of all Fire in the World, is collected out of this univerſal Element of Fire; which, perhaps, will never increaſe nor diminiſh; it being diſperſed where it is moſt invited; if therefore, I ſay, you will ſuppoſe with me, that this Air, which is full of a lambent Flame, when it has been invited by the Property ſuppoſed to be in it, that the biggeſt Body congregates the leſs; from theſe Conſiderations, I think it may be ſuppoſed, that the Flame of Fire is produced out of the Air, only; the Wax or Reſin being a fatty ſulphureous Matter, which, as Coals, may likewiſe be ſuppoſed to ſerve as a *Pabulum*, fitly adapted only to let this Element paſs through it, for the Purpoſes here deſcribed.

The more of the Air that paſſes through them, the quicker they burn; as when the Snuff of a Candle is taken off, which hindered the Quantity to paſs thro' it, it increaſes the Flame; though, before, the ſame Materials were employ'd. The ſame may be ſaid of clearing the Aſhes from, and ſtirring the Fire; which impeded the Quantity of Air from leaving its Fire behind, in its Paſſage through the Coals.

If the Wax had any Inherency of Fire in its Nature, Why, if you turn a lighted Candle downwards, does the Wax extinguiſh the Flame? If this my Conjecture be difficultly conceiv'd, pray let me farther ask, Why does a Candle, which is lighted, and let down into a Mine where there is a Damp, go out? In a large Mine there is Space enough ſurely for a Candle to burn in, if there had been enough of that *Pabulum Vitæ* left in the ſtagnated Air which occupy'd that large Cavern.

Now, if you will ſuppoſe, with me, that this Air had been robb'd of its Fire, by its ſupporting and keeping alive ſuch Things under-ground as its Buſineſs is to do every-where, and that Space was left full of ſtagnated Air, and therefore could not admit of freſh to enter, it became impoſſible for Fire, or any living Creature, to ſubſiſt there.

The Cure of this Evil is performed in Mines by a Horſe-Mill, which works large Bellows, that drive freſh Air down a Shaft made for that Purpoſe.

I remember Dr. *Halley* told me, that he once try'd the Experiment of making a factitious Damp; which he did, by exhauſting the Air out of the Receiver of an Air-Pump, and then luting to a Stop-cock a Gun-barrel; the other End of which he put into a Charcoal-Fire, and with the Air, which paſs'd thro' the Fire, he fill'd the Receiver again; he told me that it inſtantly kill'd a Mouſe he put into it, and many other Animals, juſt as Damps did: Now how will you account for this, if you ſuppoſe not that its Fire was extinguiſh'd, and carried from it another Way?

Having thus far, I hope, prepared your Mind to underſtand what I apprehend the Element of Fire is, and what its Office ſeems to be, I will ſhew, if I can,

Firſt, Why, in Electricity, Fire proceeds from an electrical Body, ſo as to light into a Flame many different Compoſitions.

Secondly, Why a Tube of Glaſs, when rubbed ſo as to be made electrical, will not only attract to it, but repel from it alternately, any light Body, as Leaf-Gold, Feathers, and the like: And alſo, why it will ſeem to ſend from it a Quantity of Wind, with a ſinging ſmall Noiſe, if you hold it nigh to your Cheek and Ear.

Thirdly, Why, when any unelectrify'd Body touches any thing electrify'd, the Electricity breaks off with a ſmart Crack, and a Spark of Fire.

Fourthly, Why a Number of Men, who are joined together by holding any metallic Body betwixt them, if one of them touch a Piece of Iron electrify'd, the whole Company ſhall feel a violent Concuſſion, in proportion to the Largeneſs of the Body electrify'd.

Firſt, I will endeavour to ſhew, Why an electrify'd Body will kindle an *Alcohol*, or rectify'd Spirit of Wine, and many other compounded Liquors, into a Flame.

After having attempted to prove to you, that the Cauſe of Electricity ariſes from the univerſal Fire ſcatter'd through all Nature, by its being rubb'd together in its Paſſage betwixt a glaſs Ball and a Piece of Leather, *&c.* I hope I ſhall make it appear, that it paſſes from thence, to the Body electrify'd, trifý'd, in a converging and diverging State; juſt as a *Lens* converges and diverges the Rays of Light which paſs through it: And that all Bodies electrify'd are ſhut up in a *Capſula* or Covering of this electric Matter, or lambent Flame, which not only paſſes over it about half an Inch thick, but pervades alſo every Part and Particle of Matter which conſtitutes that Body; which it may as eaſily do, if it conſiſted of many Tons Weight, as ſoon, and from the ſame Neceſſity, as it would do to one of an Inch Diameter: And that the electrify'd Body is intirely ſeal'd up at each Extremity.

To ſhew this Fire in a converging State, you may obſerve, when a Gun-barrel, or any long Bar of Iron, is to be electrify'd, and it is in a State of Suſ-

penſion

penſion on ſilk Cords, which are non-electricable, you may perceive the Fire iſſue from a Piece of iron Wire coming from the glaſs Ball, in a lambent Flame, which draws to a Point, and then diverges, and drives itſelf on, till the Gun-barrel, or Bar, is electrify'd.

Its being a Gun-barrel can be no other Reaſon for its Preference in that Shape than in another; but I believe the Occaſion of its being uſed here is, becauſe the greateſt Effect which has been ſhewn from Electricity, was ſent from abroad; and that was cauſed by ſuſpending a great Gun in a non-electricable ſilk Cord. The Gun ſeems to have been made uſe of here as being the greateſt Quantity of Iron, and in the beſt Shape, they could get it for Suſpenſion. And were a Perſon ſo ſuſpended, if he held in his Hand a naked Sword, you might ſee ſuch a lambent Flame paſſing from it, in a converging and diverging State, as before deſcrib'd.

I would further prove this converging Fire, from a late Experiment I have heard of, which is as follows: If you ſuſpend an iron Ball by a large Piece of Wire, which deſcends from a Bar of Iron electrify'd, and then hold under it, in a Saucer, ſome ſmall round Bubbles of Glaſs, near enough to be in Contact with the electrical *Vortex*, the glaſs Balls will follow each other round in the Saucer; and each of theſe Balls, if the Experiment be made in the dark, will appear to have a Spot of blue Flame at each End of them.

Now, as, by the Contrivance of Man, here is more of this Fire crouded

together,

together, than was intended by the Author of all Uniformity, ſeeing, by its natural Coheſion, and the infinite Celerity it is ſpirally driven on with, it is no Wonder, in this confined State, if that, which, as Water unconfin'd, would be gentle and beneficent, ſhould, with all the Power that belongs to it, break out at the firſt Door which is opened for its Paſſage from this tortur'd State.

It is no Wonder, therefore, that all undiſorder'd Nature ſhould be equally electrify'd: For how is it poſſible to have it otherwiſe? ſince, if a Perſon ſtands on the Ground, and touches but the *Capſula* before he touches the Body, the electric Fire ſtarts through him into the Ground, as ſwift as Lightning, and thence into the univerſal lambent Flame, from whence it was taken.

Lightning from hence may in ſome meaſure be accounted for; though I cannot ſo exactly tell what collects it together, as I can in this factitious Lightning here treated of, yet I can ſuppoſe, that the Cauſe of Lightning is produc'd from a great Quantity of this Fire before ſpoken of; which being driven together, and included in a limited State, or Covering of ſome Kind, when diſcharged from this Covering, it goes off in an Exploſion, which is Thunder. The Lightning I need not deſcribe, being intirely the ſame with Electricity; for it will kill without a Wound, and paſs through every thing, as this ſeems to do.

I am to ſhew, firſt, the Cauſe of its kindling a Flame in certain compounded Liquors; which, if what I have ſuppoſed be true, that it is by the means ſpoken of that this Fire is collected and driven on, as I have ſaid, it is plain to be ſeen, that at the Finger's End of a Perſon electrify'd, or at the End of a Sword, held as before deſcribed, being in a dark Room, a Flame iſſues from them: It is no Wonder then, that an inflammable Spirit, as is ſhewn, ſhould take Fire from it.

The ſecond Thing I propoſed to ſhew is, Why a Tube of Glaſs, rubb'd ſmartly in the Hand, ſo as to become electrical, repels Leaf-Gold, Feathers, and other ſmall Bodies; and when they touch any leſs electrify'd Body, they ſhall return back again to the Tube, and ſo *vice verſa*. Now, if what I have been ſaying be true, how can this *Phænomenon* be otherwiſe? For, if that Piece of Leaf-Gold, *&c.* be electrify'd by the Touch of the Tube, then it has as full Power given to it as the electrify'd Body had to give to it: And when the Gold, *&c.* touches any other Body, it imparts to it ſo much of its electrical Property as it had in itſelf: And then it may be conſider'd in the ſame State it was in when firſt electrify'd: And ſo it wil be repeatedly attracted to it, and be repell'd *toties quoties.*

But it may be asked, What cauſes theſe attractive and repulſive Faculties? I anſwer, The Attraction of fiery Particles one to another: For, if all Nature be agitated by this Fire, all Things have it in the common Proportion, as it was intended they ſhould ſtand in Nature. And therefore, as I have endeavoured to ſhew, that Electricity is occaſioned by crouding on any thing more of this Fire and Force than naturally belonged to it; and as the Flame of a Candle muſt of Neceſſity ſend out of it at its Point an Overplus (without which there could be no Succeſſion or free Motion in its Flame); ſo, for the ſame Reaſon, the Redundancy of what is crouded on may be conſider'd as ſpending itſelf at each Extremity, that it may thereby reach itſelf out to any thing, and invite it to it; as I have ſhewn the Flame deſcending down the Smoak of a Candle juſt blown out to kindle it again, will do.

As therefore there is a trite Proverb, paſſing univerſally, that *where there is Smoak there muſt be ſome Fire*, I will endeavour to prove, That no Heat, either from Animals, or from any other Cauſe, can be produced but from this ſuppoſed Fire I have been ſpeaking of. For, now, ſuppoſe you ſee the Flame of a Candle circumſcribed and limited in its Shape and Size, which it has according to its Snuff; this Thought may ſerve to illuſtrate what I mean by the *Capſula*, which I have ſuppoſed paſſing over the Surface of every Body when it is electrify'd, and ſeems to be a lambent Flame, being more or leſs thick, as from the *Apparatus* more or leſs Fire has been collected and rubbed together on it, either from the Friction of a glaſs Tube, or the Globe: Now, as what I am about to ſhew, is, why this attractive Faculty is found in this Experiment, I would offer to your Conſideration, Whether, when common People ſee the Flame of a Candle circumſcrib'd, they think of any Fire which may proceed further than in the Flame of that Candle? Yet every body, on Recollection, knows, that the Flame will heat Parts at a great Diſtance to ſuch a Degree, as, at length, to kindle them into a Fire. And tho', till you touch the Flame, your Finger is not immediately burn'd, yet there are ſhewn to be Emanations of Fire at a Diſtance from its burning Quality. So here I beg Leave to conſider the ſame Property in this Fire occaſion'd by Electricity. For, till you touch this *Capſula* of lambent Flame (which is commonly to be met with near a Quarter of to Half an Inch ſhort of the Body to be electrify'd) no Effect is perceiv'd, becauſe you have not enter'd into the *Vortex* of this Whirlpool of Fire: Yet you may ſuppoſe that it ſends out an Emanation of its Fire beyond it, as other Flames do; which, when it has firſt, by its Heat, (which I take to be Part of it) prepared ſmall

Things to be electrify'd, then they are more eaſily lick'd into the whole Power, and ſo become electrify'd. The Reaſon therefore, why the Gold, and other light Materials, (which I have ſuppoſed to have ſome of this Fire in them) are attracted, is, the Invitation they receive from the curling *Effluvia* to a cloſer Contact: And when it has received as much as the former can give it, its Invitation ceaſes, till it has parted with what it had to its Neighbour; and then it is again invited as before.

I come now to conſider the Violence of this Fire; which, paſſing thro' the Pores of the glaſs Tube, may, as the Sound of Organ-Pipes, which proceeds only from their differently modifying the Air, cauſe the various hiſſing Noiſes you hear when the Tube is held nigh the Ear, from the Electricity paſſing through the different ſhaped Pores of it.

And furthermore the Wind may ſeem to ariſe, from the diſtant Parts of the electrical Force playing at ſome Space from the Tube; which thereby agitate and fan the ambient Air, ſo as to make it feel like Wind.

The third Thing I propoſed to ſhew, is, Why the electrical Power departs from one Thing to another by giving a ſmart Crack, and ſendout a Spark, which will ſet on fire many very inflammable Liquors.

Now, (as I have, I hope, demonſtrated) when this Fire of Electricity is iſſuing out at a Point into an inflammable Spirit, it can be no Wonder, that the Spirit, which is known to be full of Fire, ſhould unite its Fire to that of Electricity.

As to the Crack it gives when this Fire paſſes away: As all Sounds are occaſioned only by the Air's being put into a different Modification, it is here natural to ſuppoſe, that as the Cracking of a Whip is cauſed by the ſmart Stroke at the Point of it on the Air, ſo, in this Caſe, the Air ſeems to be agitated in the ſame manner, by breaking the Continuity of it, whereby the like Sound is perceiv'd.

The next Thing I propoſe to account for, is, Why a Company of unelectrify'd Perſons, who are joined together by their holding each a Piece of iron Wire betwixt them, tho' they are ever ſo many, do all receive a violent Blow or Concuſſion on their

Bodies, when one of them touches a Piece of electrify'd Iron.——I think this Experiment may be carried ſo far, that, as it has been found already ſufficient to kill Birds, and hurt many Perſons very grievouſly, it may have Force enough given to it to kill a Man, as effectually as the Darting of Lightning can do.

For if you conſider, that you may as effectually electrify one Quantity of Iron as another, that it may be done to many Ton Weight as eaſily as to a ſmall Piece, and that, when it departs into a Perſon, all the Power given to it, not only on its Surface, but intimately thro' every Pore and Particle of it, darts like Lightning from the Point only it was touch'd in; then further think, that if this Repercuſſion, or infinite Recoil, from ſo large and ſolid a Body, be ſo great, when its Power is thus ſent, what may it not do in its utmoſt Extent?

Having now, I think, gone thro' what I propos'd to ſhew, and given a Reaſon, as far as my Conjecture reaches, for every *Phænomenon* which I have ſeen or heard of in Electricity, I think it may not be improper to endeavour to proceed a little farther with it, and conſider its Power as it ſtands in Nature. For, ſince the Antients have ever ſuppoſed ſome uniform compulſive Power, which they called the *Anima Mundi*, and which by theſe electrical Experiments ſeems to be Fire, I will endeavour to ſhew, that, in the Diſperſion of it in common Nature, you may obſerve that ſome Plants abound with it, from the great Vigour they diſcover, compar'd with others in their own Tribe. Some are ſo, as being of a more verdant Nature than others are. Now, from this Conſideration, I will venture to give a Reaſon for that which has hitherto puzzled every body that has thought about it, which is, Why the Senſitive Plant ſhrinks; and, from a turgid and vivid Appearance, it immediately becomes languid, and hangs its Leaves, on the Touch of any other Body or Thing.

Now, from this my Conjecture on Electricity, if you will ſuppoſe with me, that as all Things, which ſtand in the common Nature of this lower World, have this Fire equally diſperſed, and have more or leſs of it only as they are in this or that Place, where more or leſs of it is offer'd to be received by them, or as they are in their own Natures more capable of receiving more of it than others are, (as I think has been ſhewn by the electrical Experiments before-mention'd) and then likewiſe ſuppoſe the Nature of the Senſitive Plant is to have more of this Fire in it than there is in any other Plant or Thing, and it muſt, by the Nature of it, when any of them touches it, impart a great deal of its Fire into that Thing by which it is touched; becauſe that had leſs of it than was in the Senſitive Plant. Therefore, till the Senſitive Plant has had Time to recover its Vigour, by receiving from the Air more of this Fire, its Leaves and Branches hang in a languid State, from the great Loſs of its Spirit and Fire.

To illuſtrate this, if you ſet any ſmall Tree in a Pot upon a Cake of

Reſin, and then electrify the Tree, even tho' it were a Willow, it would grow extremely turgid, ſo as to erect its Leaves to the great Wonder of the Beholder; and the Moment you touch even but one of its Leaves, the whole Tree becomes as languid as the Senſitive Plant would be, if touched by any Body or Thing. --- This I think ſeems to me to give as great a Proof of the Truth of my Conjecture as the Nature of the Thing can admit of, reſpecting the Senſitive Plant.

As I am upon the Subject of Vegetation, it may not be improper to offer ſomewhat concerning the Direction of the *Farina fecundans*, which is found in Plants and Flowers, to the *Matrix* of that, or of a neighbouring Plant or Flower.

Now, if there was not ſome very attracting Influence to guide it, it would but ſeldom happen, I think, that they could come together by Chance. ---- If therefore you ſuppoſe, that both the *Matrix* and the *Farina* abound with more of this Fire than is in any other Part of the Plant, or Flower, this great Wonder is at an End: For, by the natural Attraction there might be in each, from the Fire ſuppoſed to be in them, they would fly together, and be cloſely connected, as they are conſtantly found to be in their proper Seaſon.

I have mention'd, that the *Farina* of one Plant may impregnate the *Matrix* of another as well as its own; becauſe I have obſerved formerly, at Mr. *Fairchild*'s, a Gardener at *Hoxton*, a Mule-Flower, begotten betwixt a Pink and a Sweet-William.

Having conſider'd how this electrical Power may be ſuppoſed to affect Vegetation in its common Growth, I ſhall reflect a little further concerning it, as it may affect animal Life.

We may obſerve univerſally, that Youth abounds with infinitely more Spirits than Age doth, as well in the Human Species as in the Brute Creation; as it is clearly ſeen in Children, compar'd to Adults; as alſo in Lambs, in Colts, in Kittens, and almoſt all other Young, they being much more vigorous than their Dams are generally ſeen to be. Now what Reflection I would make on this, is, That if Life in them, and in all Nature, be owing to the ſame Fire as cauſes Electricity, then, from thence may proceed the Danger of lodging old

People with young Children; who, by long Experience, have been found to draw from young Children their natural Strength; the old People having in them a leſs Proportion of this Fire than young ones ſeem to have.

Being about to ſhew the Evil as well as the Good ariſing from this ſuppoſed Fire, I will, in the next place, endeavour to demonſtrate, the Cauſe of Blaſts in Mankind; and alſo to give ſome Reaſon for the Blights on Trees, which I think may be occaſioned by this Fire before ſpoken of.

Having given ſome Account of the Fire which was ſeen in the high Wind, to corroborate that Truth, I think it proper to inform you, that I have been told, by very good Authority, that, in tempeſtuous Weather at Sea, great Flakes of Fire are frequently ſeen paſſing not only in the Air, but on the Water alſo: And having myſelf ſeen the Sea-Water, in the Night-time, appear to have a great Quantity of Fire iſſuing out of it, when the Surface thereof was diſturbed by the Feathering of Oars, or by the Veſſel or Boat paſſing ſwiftly through it, I asked a Sailor, At what Time that Appearance happened moſt frequently? He told me, It moſt generally happen'd after tempeſtuous Weather; or, as his Term was, dirty Weather at Sea.

I think this will ſufficiently ſhew the Exiſtence of this Fire in the Air; and, if any Regard be had to what I think its Power and Uſe is in the World, that it will intrude itſelf and force its Way into any Thing where leſs of it is, and ſo join itſelf to it by being in a greater Quantity; as has been ſhewn by many electrical Experiments.

You may ſuppoſe a Perſon ſitting, as it is too frequently found they are, near a Door, or in a Window, when they are in a warm Temperature, and in Perſpiration; if you believe that there can be any Probability in the Conjecture I have offer'd to your Conſideration, is it not natural for any of this Fire, which paſſes as frequently through the Air in the Day-time (though unobſerved) as when it is ſeen in the Night; I ſay, Why is it not natural for it to force its Entrance into any Perſon or Thing? eſpecially as it comes then with the Aſſiſtance of the Stream of Air the Perſon ſits in, and with which it is driven.

In order to make this Miſchief the more to be regarded, I will endeavour to ſhew the natural State of the Air itſelf.

Many Writers about it chuſe to divide it into two Sorts; the firſt is the pure *Æther*, which is ſuppoſed to be moving above our Atmoſphere; the ſecond is the common Air, which is ſuppoſed to be within our Atmoſphere. I confeſs, the Feats attributed to the mighty Weight of our Atmoſphere, in cauſing Siphons and Pumps, *&c.* to operate, I never could underſtand; but if I were to account for their Operations, as well as that of a Barometer, by the Elaſticity of the Air, I think I could more eaſily and more naturally ſhew it.

Notwithſtanding what has been advanced concerning the *Æther*, which is believed to inhabit above our Atmoſphere, I chuſe rather to ſuppoſe, that the Air is an Element as well as Fire, and that the Difference in it is only betwixt heavy and foul Air, and clean and light Air. That which comes on the higheſt Mountains is clean, and free from our Fogs and Putrefactions, and, conſequently, more elaſtic.

As a Proof of this, I would recommend the following Experiment: Fill a Bladder with this clean Air; then preſs it with a Weight juſt ſufficient to make it give way; and you will find, that, by reaſon of its Elaſticity, it will yield much further, than if it were fill'd with the other Air, which is impregnated with foggy and aqueous Particles.

Now if, as in a Barometer, the Quickſilver is ſuſpended by the Air on the Top of the Tube, which was extracted or emerged out of the Quickſilver, by the Weight of the ſaid Quickſilver, and as that Air in the Barometer cannot but have a Communication with the ambient Air, the Air within the Barometer muſt thence be affected, by its becoming leſs elaſtic alſo.

But this is not ſo much to my preſent Purpoſe, as to conſider the Air loaded not only with Vapours, but with poiſonous *Effluvia* from the Steams of various Minerals, as well as with the Salts of dead Inſects and Animals, which, in the Seaſon of Autumn, may probably occaſion ſo many Agues, and putrid Fevers, as are met with.

Now, if you further conſider the Air as loaded with any or all of theſe Vapours and *Effluvia*, and demanding Entrance with the Authority of Fire, its Companion, is it any Wonder, that the Rheumatiſm, and many other bad Effects, which frequently happen, in unguarded Seaſons, to Mankind, may be owing to the Cauſe here treated of?

I remember that a Perſon, riding in an open Chaiſe, in an Eaſterly Wind, receiv'd a Stroke upon one of his *Scapula's*, with as great Pain, and with the ſame kind of Senſation, as if he had been ſtuck with a Dagger. Upon which he inſtantly ſaid to his Friend in the Chaiſe, He expected a violent Rheumatiſm from it. Which accordingly happen'd; for he was not able to quit his Bed for Three Weeks after. ---I think this cannot be better accounted for, than to ſuppoſe it proceeded from a pointed Body of this kind of Fire, and the *Effluvia* which accompanied it.

If you will be pleaſed to reflect on the Air in this laſt deſcribed State, you need not expect, I think, to have much ſaid concerning the Blights on Trees. It is true, ſomewhat may be conſider'd with regard to the Inſects frequently found on the blighted Leaves: But whether, when by the Blight the Leaves have been curl'd up, the Inſects come there as to a proper *Nidus*, or whether they are brought in this Fire, which ſeems plainly to have burn'd the Leaves, I will not undertake to account for.

I am, &c.

APPENDIX.

THE kind Reception this ſmall Treatiſe has met with from the Public occaſions the Printing this Second Edition of it.

It is, I confeſs, ſome Satisfaction to me, that my publiſhing it is not without Part of the Effect I hoped for; having been told by many, who have read it, that it gave them very new and ſatisfactory Ideas.

As to thoſe who have read it, and ſay nothing of it, either from their Want of Apprehenſion, or their Fear of being obliged to alter their Sentiments concerning it, or from a worſe

Cauſe than either, I abſolutely have no Concern about them.

There are thoſe, I confeſs, who merit with me the higheſt Eſteem, who, having read it, object to ſome Things, as fearing I have not conceiv'd them rightly; but this they have done with the Temper of Gentlemen. Theſe I think deſerve to be ſet right; which I will therefore attempt to do in the following Manner:

The Firſt Objection they make is, That I have called Silk, Wax, *&c.* which do not ordinarily convey the electrical Power to other Bodies, non-electricable, or non-electrical; when other Writers have long ſince agreed to call them Electrics *per ſe.*

The Second Objection is, That what I have advanced, to prove that the Power of Electricity proceeds not from the *Apparatus*, but from the Air, ſeems to be overthrown; becauſe, ſince I wrote my Book, there has been a new Experiment made, by placing the whole *Apparatus* on Wax, and alſo the Perſons concerned in the Experiment, and by that means the Power is intercepted.

The Third Objection is, That ſo large a Quantity of Iron, as I have ſuppoſed to be electrify'd, will not give greater Force, when touch'd by a Perſon unelectrify'd, than a ſmaller one will.

In Anſwer to the Firſt Objection; I cannot think, that the Term Electric *per ſe* is ſuited to any Material whatever; unleſs ſome One was found out which would attract to it, of its own accord, any other Material;

as we find a Loadſtone will do, when placed near any thing in its Reach : but, if you lay even Amber unrubb'd in Contact with Straws, or any other Things, they will not be attracted to it. So that Friction, it is plain, collects this Power to the Amber.

The Term Electric *per ſe* ſeems to me to be uſed by theſe Gentlemen for the ſame Purpoſes as the old Term of *Occult Quality* was.

As the Word Electricity ariſes from Amber, I need not inſtance in any other Material ; nor need I give again my Reaſons, why certain Things are non-electricable. But, for clearing One Point, in which I am not rightly apprehended ; I have ſaid, That if Fire be the Cauſe of Life and Increaſe in any thing which ſtands in a State of Nature, then, whetever ceaſes to be in a State of Life or Increaſe, muſt have its Fire withdrawn, and it becomes a *Caput Mortuum.* —— I have been told, This is not true; for a dead Animal will be electrify'd.

This I complain of, as not having been underſtood concerning it. This Animal, though kill'd, had once its animal Increaſe from Fire. Boards, when dry, have Fire in them; becauſe the Fire, which invigorated the Tree they were ſaw'd out of, muſt naturally remain in them. The like may be ſaid of a dead Animal; but Wax, Pitch, Reſin, and the Tribe of Non-electricables, never had their Exiſtence from Nature only; and therefore they are quite of a different Tribe. For what I ſay is, That whatever had once Fire in it is capable of being electrify'd. Thoſe called Electrics *per ſe*, having no Fire in them, when, by Friction, Fire is collected on their Surfaces, it is either driven from thence into the Air, or into ſome Electricable, and ſo it joins with that Fire which naturally belongs to it.

Sealing-wax is compounded of Non-electricables, and, if you rub it, will attract Things to it as Amber will: And I believe all other Things, which will not imbibe the Fire into them, when by Friction it is collected on their Surfaces, will diſpoſe of it thence to their next Neighbour. Reſin and Pitch, from their Tenacity, may difficultly be made to do it, and yet have the Nature in them I am ſuppoſing them to have.

There may be ſuch artful Tricks play'd with this Power, as, to an undiſcerning Eye, may make it ſeem to be changed; for Inſtance, If you wet a ſilk Cord (Water being electricable) it paſſes on the Water through the Cord, by the Cord's only retaining the Water. Some Dye, with which Silk is dyed, if it be of a vegetable Nature, will convey this Power through the Silk, by the Contiguity of the Dye-Stuff: So that you ſee there may be no End of Experiments.

I think it is a great Pity that the Word *Electricity* ſhould ever have been given to ſo wonderful a *Phænomenon*, which might properly be conſider'd as the Firſt Principle in Nature. Perhaps the Word *Vivacity* might not have been an improper one; but it is now too late to think of changing a Name it has ſo long obtain'd.

As I am going to anſwer the Second Objection, I own I have not employ'd myſelf in making Experiments in Electricity, chuſing rather, if I could, to account for thoſe which have been found out by others, than to ſpend much Time in making them myſelf: Though I pay great Reſpect to thoſe, who, for Improvement of Knowlege, have been employ'd in them. As to thoſe who get Money by ſhewing theſe Experiments, I do not pay ſo high a Regard to their Performances; becauſe all, who ſhew any Arts to new Cuſtomers, for Profit, are bound to try all Means to gain Applauſe. I would endeavour to aſcertain the Laws or Principle by which they are perform'd; which when done, a Thouſand Tricks like Legerdemain may be performed by it, by him whoſe Time is little worth.

In the Second Objection it is ſaid, I am miſtaken, when I advance, that the *Apparatus* is not the Cauſe of Electricity, but that it is produced by the Air. To ſhew this, I am told, That if a Perſon is placed, and alſo the *Apparatus*, on Wax or Reſin (which are non-electricable), no Fire or Force is produced from them: But if the Perſon employ'd in doing it touches the Wainſcot or the Floor with a Walking-Stick, or the like, the Electricity flows as freely as if he ſtood on the Floor. From whence ſome conjecture this Power comes from the Earth only; than which I think nothing can be more abſurd: For, if you fetch it out of the Wainſcot, or the Boards of the Floor, it muſt firſt be in them, and the Air could only be the Carrier of it to them. So that here the main Things, which I at firſt only conjectur'd, I think are fully proved; which are, That Electricity was not generated by the *Apparatus*, but only collected by it out of the Air.

As to the Third Objection to a larger Quantity of electrify'd Iron not giving greater Force than a ſmaller, it ſhould be obſerv'd, that in this Eſſay I have only conjectured what moſt probably is true: And as I profeſs not to have been engaged in making electrical Experiments, I muſt rely on thoſe only who have made them: But, ſurely, if there may be too much Iron employ'd to be ſo affected, as I have imagined, there may alſo be too little; and therefore Time may yet ſhew, that ſuch a Quantity of this Power may be ſo collected as to kill a Man; ſince but Yeſterday I was informed, that a Perſon, who lives in the *Strand*, is now recovering from a Palſy, a Palſy, in which he loſt his Speech, and other Intellects; which Miſchief he received from this Force of Electricity.

I hope what I have written on this Subject will not call on me, from the thinking Part of Mankind, any undue Reflection: I have nevertheleſs met with ſuch an unmannerly Abuſe from a Country Show-man, who publiſhed ſome Experiments, and owns he added the Preface to it, in order to write what I am ſure no Gentleman would have written — If this Perſon be poor, and did it for Gain, I heartily pity him. He owns he was much affrighted, when he heard of my publiſhing this Piece, becauſe of the hard Fate, he ſays, of his Bookſellers; but, before he had read Two Pages, he likewiſe owns he recovered his Spirits, when he found I pretended to think for myſelf, and did not let Sir *Iſaac Newton* think for me, after he had been ſo long dead. I am well ſatisfy'd, had that Great Man been living, and had ſeen theſe electrical Experiments, he would not have bow'd low to this great Philoſopher, for thus ſupporting his Character. His doing this would be as ridiculous as to ſee a Pygmy attempt to carry a Giant. I believe there are more Anſwers to Books written to pay a Landlady, or an Alehouſe-Score, than from any other Cauſe; eſpecially, if they think they anſwer one whoſe Character will call it into the World. —— I know nothing of my Adverſary's Finances; but how rich ſoever he may have made himſelf by his Show, he ſeems to have the Bleſſing of never being liable to the Head-ach from his Thinking too intenſely.

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